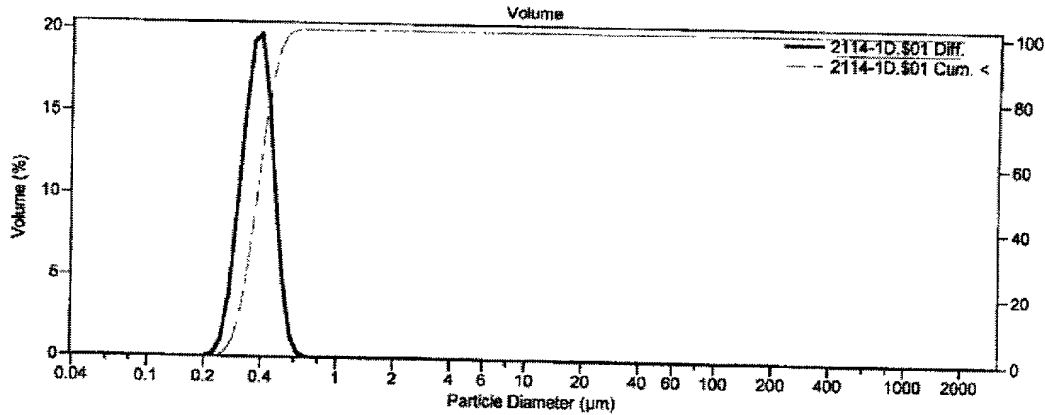
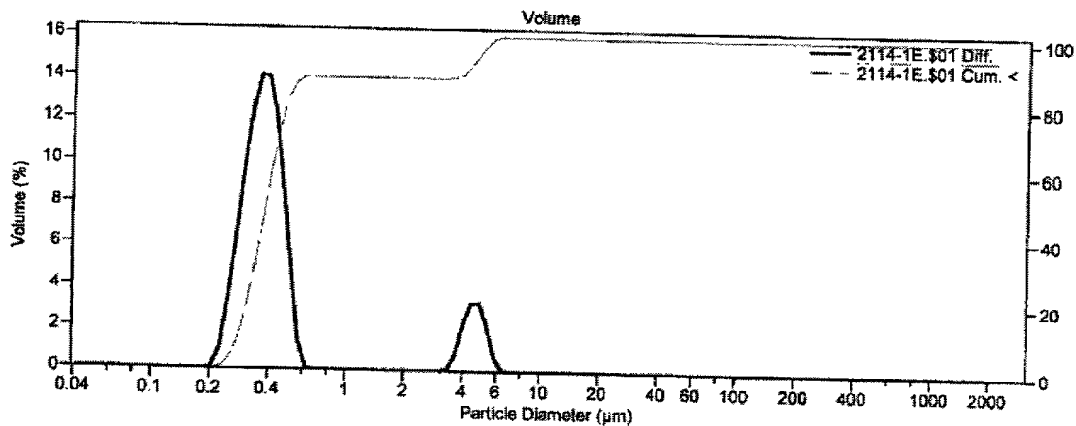


streams where about 6.0 gallons per minute was diverted through a conduit to the inlet of the IKA Works Dispax mixer (F4) and about 6.0 gallons per minute was pumped through a conduit to storage (F5). This process has been shown to produce a water in oil emulsion with the following particle size distribution:



The particle size of the resulting emulsion made by the continuous process with an identical formulation made via a process without the emulsion co-feed (i.e. F4 = 0 gallons per minute) is shown below:



The example showed that a continuous process using an emulsion co-feed unexpectedly consistently produced higher quality results.

The aqueous hydrocarbon fuel emulsion product produced by the continuous process involves less processing time than by batch processing. Thus, the inventive process to make the same water-blended fuel product is an improvement over other processes because of the increased throughput and efficiency.

The Hydrocarbon Fuel

The liquid hydrocarbon fuel comprises hydrocarbonaceous petroleum distillate fuel, non-hydrocarbonaceous materials that include but are not limited to water, oils,

liquid fuels derived from vegetables, liquid fuels derived from minerals and mixtures thereof. The liquid hydrocarbon fuel may be any and all hydrocarbonaceous petroleum distillate fuels including not limited to motor gasoline as defined by ASTM Specification D439 or diesel fuel or fuel oil as defined by ASTM Specification D396 or the like (kerosene, naphtha, aliphatics and paraffinics). The liquid hydrocarbon fuels comprising non-hydrocarbonaceous materials include but are not limited to alcohols such as methanol, ethanol and the like, ethers such as diethyl ether, methyl ethyl ether and the like, organo-nitro compounds and the like; liquid fuels derived from vegetable or mineral sources such as corn, alfalfa, shale, coal and the like. The liquid hydrocarbon fuels also include mixtures of one or more hydrocarbonaceous fuels and one or more non-hydrocarbonaceous materials. Examples of such mixtures are combinations of gasoline and ethanol and of diesel fuel and ether. In one embodiment, the liquid hydrocarbon fuel is any gasoline. Generally, gasoline is a mixture of hydrocarbons having an ASTM distillation range from about 60°C at the 10% distillation point to about 205°C at the 90% distillation point. In one embodiment, the gasoline is a chlorine-free or low-chlorine gasoline characterized by a chlorine content of no more than about 10 ppm.

In one embodiment, the liquid hydrocarbon fuel is any diesel fuel. Diesel fuels typically have a 90% point distillation temperature in the range of about 300°C to about 390°C, and in one embodiment about 330°C to about 350°C. The viscosity for these fuels typically ranges from about 1.3 to about 24 centistokes at 40°C. The diesel fuels can be classified as any of Grade Nos. 1-D, 2-D or 4-D as specified in ASTM D975. The diesel fuels may contain alcohols and esters. In one embodiment the diesel fuel has a sulfur content of up to about 0.05% by weight (low-sulfur diesel fuel) as determined by the test method specified in ASTM D2622-87. In one embodiment, the diesel fuel is a chlorine-free or low-chlorine diesel fuel characterized by chlorine content of no more than about 10 ppm.

The liquid hydrocarbon fuel is present in the aqueous hydrocarbon fuel emulsion at a concentration of about 50% to about 95% by weight, and in one embodiment about 60% to about 95% by weight, and in one embodiment about 65% to about 85% by weight, and in one embodiment about 80% to about 90% by weight of the aqueous hydrocarbon fuel emulsion.

The Water

The water used in the aqueous hydrocarbon fuel emulsion may be taken from any source. The water includes but is not limited to tap, deionized, demineralized, purified, for example, using reverse osmosis or distillation, and the like. The water includes water mixtures that further includes antifreeze such as alcohols and glycols, ammonium salts such as ammonium nitrate, ammonium maleate, ammonium acetate and the like, and combinations thereof.

The water may be present in the aqueous hydrocarbon fuel emulsions at a concentration of about 1% to about 50% by weight, and in one embodiment about 5% to about 50% by weight, and in one embodiment about 5% to about 40% being weight, and in one embodiment about 5% to about 25% by weight, and in one embodiment about 10% to about 20% water.

The Reactant Emulsion Component

The reactant emulsion is at least one of the ingredients in the process and not necessarily a reactant in a chemical reaction. The reactant emulsion comprises the hydrocarbon fuel, water and at least one emulsifier. The reactant emulsion may be prepared by the steps of (1) mixing the fuel and an emulsifying amount of at least one emulsifier using standard mixing techniques to form the initial emulsion component or, in the alternative, under emulsification mixing conditions to form the reactant emulsion. The reactant emulsion can be prepared from any emulsion process including the process of this invention. It is in effect a recycling of a finished emulsified fuel into the process for making more emulsifier fuels.

The initial emulsion component contains about 50% to about 99% by weight, in another embodiment about 85% to about 98% by weight, and in another embodiment about 95% to about 98% by weight hydrocarbon fuel, and it further contains about 0.05% to about 25%, in another embodiment about 1% to about 15%, and in another embodiment about 1% to about 5% by weight of the emulsifier.

The reactant emulsifier can have the same, similar or a different emulsifier and the same, similar or different fuel then is used to form the aqueous hydrocarbon fuel emulsion. The emulsifier includes but is not limited to:

(i) at least one fuel-soluble product made by reacting at least one hydrocarbyl-substituted carboxylic acid acylating agent with ammonia or an amine including but not limited to alkanol amine, hydroxy amine, and the like, the hydrocarbyl substituent of said acylating agent having about 50 to about 500 carbon atoms;